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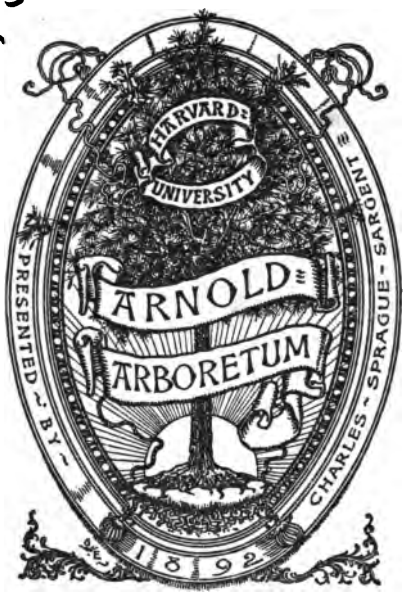

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SOME ADDITIONAL NOTES

UPON

TREES AND TREE PLANTING IN MASSACHUSETTS.

BY

C. S. SARGENT,

DIRECTOR OF THE ARNOLD ARBORETUM OF HARVARD COLLEGE.

PRINTED IN THE ANNUAL REPORT OF THE MASSACHUSETTS STATE BOARD OF AGRICULTURE.

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SOME ADDITIONAL NOTES UPON TREES AND TREE PLANTING IN MASSACHUSETTS.

BY C. S. SARGENT,

DIRECTOR OF THE ARNOLD ARBORETUM OF HARVARD COLLEGE.

The subject of economic tree planting in Massachusetts was discussed by me in two papers * published in the reports of the Massachusetts State Board of Agriculture for 1875 and 1878. Many of the conclusions reached in those papers, however, have not been substantiated by further investigations upon the same subject made during the past ten years. When they were prepared, I, like most American writers upon subjects relating to forestry, was strongly impressed with the value of various foreign trees for general cultivation in this State. I am now as fully convinced that the native trees of Massachusetts are better suited to Massachusetts than any exotic trees can be, and that if our woods and plantations are ever to assume real importance, and to make profitable returns upon the money invested in them, they must be composed either wholly or in large part of our native trees. Some of the most valuable timber trees known to man flourish naturally within the borders of this State, or may be found not far beyond its limits; but this material, placed within easy reach of Massachusetts planters, has been too often neglected, and in some conspicuous cases has been entirely replaced by foreign trees, which, as it is now known, are incapable of flourishing here for any length of time, or of yielding adequate returns for the time and money expended upon their cultivation.

* A Few Suggestions on Tree Planting. Notes on Trees and Tree Planting.

The passion for cultivating exotic trees is not new. The possibility of increasing the productive capacity of a country through the introduction of some foreign tree of first-rate importance has long occupied the attention of the most enlightened rural economists. This desire to increase the value of forests by the introduction into them of the best trees of foreign countries has been a powerful stimulant to botanical and especially to dendrological research; it has vastly increased the interest in horticulture, and extended, sometimes dangerously, it is true, the possibilities of the gardener's art. The purely economic results, however, obtained in northern Europe and in the United States during the last fifty years of great activity and interest in the introduction and cultivation of exotic trees are not encouraging. While Europe been able to enrich and beautify her ornamental plantations from the forests of America, and especially from the great coniferous forests of western North America, and from those of western and southern Asia and the Caucasus, European forests, planted with the object of producing timber only, are still, with a few English exceptions, exclusively composed of half a dozen species of trees, native of central Europe. This is not the result of prejudice nor of ignorance. European foresters have long studied, and are still actively and widely studying, the possibility of profitably introducing on a large scale various foreign trees into their great artificial forests. The results thus far obtained, however, from these investigations show that while a foreign tree may often possess very great value in ornamental plantations, it is the native trees only of a country which can always be safely depended upon in that country to make profitable money returns to the planter.

Europe has done little to beautify the plantations of New England; the Norway maple, the horse chestnut, which must now be considered a European tree, the elm, the beech, the birch, the willow and the larch, none of them, in our climate, equal in mere beauty to their American congeners, with the exception, perhaps, of the willow, are the only European trees which seem capable of reaching any great age or development in this State. Western Asia has given us the ginko, the mulberry and the ailanthus, really

valuable additions to our plantations, besides many other trees, especially conifers, about which it is too soon yet to speak with any degree of certainty, although the similarity between eastern Asiatic and eastern American climates is marked enough to induce the hope that the plants of one of these regions will flourish in the other. If foreign countries have done little for our ornamental plantations, they have done still less for our forests.

There is certainly no proof yet, and perhaps no very strong indication even, that any foreign tree, with the exception only of the willow,* yet introduced into Massachusetts, has qualities not possessed in a greater degree by some native tree, which would recommend its general cultivation in economic forest planting, although it is, of course, too soon yet to pronounce with perfect confidence upon all the foreign trees introduced into our plantations. Individual interest, which has cultivated here foreign trees, and especially European trees, often upon a large scale, has made it possible to determine at least that many trees, largely cultivated in Europe in economic forests, and in America in ornamental plantations, are utterly unsuited to our climate. Too much praise can hardly be given to the men who have been patiently testing here for years the merits of foreign trees, and the recognition of their service to Massachusetts agriculture should be all the more strongly expressed, because, so far as they are concerned individually, such experiments have generally resulted in failure and disappointment.

The facts which have been established and the lessons which may be learned from these arboricultural experiments which have been carried on in Massachusetts during the last seventy-five years with more or less intelligence and persistency are, in regard to certain European trees, briefly these:

The European lindens, of which two or three species are cultivated in Massachusetts, are in every way inferior here, except in perfume of flower, to our native species. They suffer greatly from the attacks of various wood-borers, and usually perish before reaching any great age. The sycamore maple (*Acer pseudo-platanus*), a common European

* A Few Suggestions on Tree Planting, p. 25.

species, largely cultivated there for its valuable timber, and early and quite generally planted in eastern Massachusetts, grows, like many European trees, very rapidly while young, but is soon unsightly here, short lived, and quite worthless for any economic purpose.

The Norway maple (*Acer platanoides*) is a more valuable tree here, although greatly inferior to our native sugar and red maples in beauty and general usefulness. It grows rapidly and vigorously in Massachusetts, especially near the sea, reproducing itself freely, and giving every promise of reaching as great development as in its native land. The fact that its leaves are often covered with thrip and red spiders during the summer months, especially when planted beyond the influences of sea-breezes, is the only drawback yet discovered to the general introduction of this tree into ornamental plantations, and especially sea-coast plantations, in Massachusetts. The European ash (*Fraxinus excelsior*), and its innumerable varieties, once largely and now occasionally planted in Massachusetts, are here short lived, brittle and utterly worthless trees, which should be exterminated in every Massachusetts plantation, to make room for our noble white ash (*Fraxinus Americana*), which nowhere thrives with greater vigor or yields better returns to the planter.

It is too soon, perhaps, to speak with any degree of certainty in regard to the future of the European sycamore (*Platanus orientalis*) in Massachusetts. Young trees, however, forty or fifty years old, grow with a vigor now never attained by our native species, and certainly give promise of long life and full development. Two species of elm (*Ulmus campestris* and *U. montana*), natives of Europe, thrive as well or nearly as well in Massachusetts as any of our native species. Specimens of the former * attain a size in eastern Massachusetts never reached here by any other foreign tree, with the exception, perhaps, of the white willow; while the Dutch elm (*U. montana*), now everywhere, reproduces itself from seed, and will doubtless eventually become completely naturalized in our woods.

The European oak (*Quercus robur*) has always been a

* A Few Suggestions on Tree Planting, p. 24.

favorite tree among Massachusetts planters of a certain class. This tree grows here very rapidly when young; it can be easily raised and very easily transplanted; its habit is excellent, and it carries its green foliage into early winter, long after our native trees have shed their leaves. It is, perhaps, however, the most unsatisfactory deciduous tree which has ever been planted in Massachusetts. The promise of its early life is never realized. The European oak begins to fail in Massachusetts when about twenty years old, with the cracking of the main stem, and then, after dragging out a wretched existence for a few years longer, miserably perishes. Tens of thousands of these trees have been planted in this State during the last century, but it is now almost impossible to find anywhere a healthy specimen more than thirty years old, while all the older trees have now almost entirely disappeared from the neighborhood. Massachusetts planters, whether they plant for ornament or for profit, have no occasion to go far beyond the limits of their State to seek material for their plantations of oak.

The European beech (and its varieties), although, perhaps, less beautiful and certainly less graceful than its American prototype, grows and thrives in Massachusetts, if not as freely as in Europe yet sufficiently well to make it an interesting and valuable addition to all ornamental plantations here. The European birch, very like one of our smaller American species, and its numerous varieties, are graceful additions to our garden sylva, although not to be compared in beauty, vigor, and in economic value, with several of the birches native of this State.

The white willow of Europe (*Salix alba*) grows as freely and reaches as large size in Massachusetts as it does in Europe, and is now very generally naturalized in the neighborhood of all our principal centres of population. It surpasses in size and exceeds in value any American willow, and might be profitably cultivated wherever there is any demand in this country for willow timber.

The European poplars are inferior here to our native species in beauty, rapidity of growth and general usefulness, although landscape gardeners will find it difficult to produce certain effects without the pyramidal Lombardy poplar,

which, however, never reaches here a vigorous old age. The silver poplar or abele (*Popolus alba*) is here a very hardy, fast growing, although unsightly, tree, of no commercial value, and filling the ground in its vicinity with troublesome suckers. It should no longer be planted in Massachusetts.

If Europe has given us few valuable deciduous trees, its contribution of conifers to our plantations is still less important. It was once believed, and no one, perhaps, was more firmly impressed with this belief than myself, that the Scotch pine (*Pinus sylvestris*), one of the great timber trees of northern Europe, was destined to become an important economic factor in New England forests and plantations.* This opinion, based upon the deceptive and insufficient evidence of the early promise of this tree, was reached too hastily. The past ten years have shown that the Scotch pine is a failure in New England as an ornamental and as a timber tree. It is very hardy; it grows quickly and easily from seed, and young plants can be raised and sold more cheaply, perhaps, than the seedlings of any other coniferous tree. These are not fastidious about soil and are proof against any exposure or hardship. The young trees, during the first twenty years of their life, grow with astonishing rapidity, and then either die outright, from some as yet inexplicable cause, or begin to fail gradually, and perish long before reaching maturity. It has cost American planters something in money and a great deal in disappointed hopes to discover the worthlessness of the Scotch pine in this country. If, however, they have learned, at the same time, the folly of pronouncing upon the value of any exotic tree in any country, until it has been generally tried in that country during at least as many years as it requires to complete its individual existence, their experience with the Scotch pine has not, perhaps, cost them too dearly. The Scotch pine is still raised and sold in great numbers in some parts of the West, where the rapid growth and perfect hardiness of the young plants on the northern prairies make it indispensable in all wind-breaks and shelter plantations, at

* A Few Suggestions on Tree Planting, p. 27.

least in the opinion of men engaged in selling the plants to settlers.

The Austrian pine (*Pinus Austriaca*), less widely planted and less thoroughly tried in Massachusetts than the Scotch pine, promises also to prove a total failure here. The young plants grow rapidly and are very hardy, but they begin to fail early, and will probably disappear entirely before they are fifty years old. This species is liable to suffer from the attacks of wood-borers in the main stem. The cultivation of the Austrian pine in Massachusetts should now be abandoned, and our native red pine (*Pinus resinosa*), a more beautiful and in every way more valuable tree, substituted for it. The Corsican pine * (*Pinus Laricio*), of which the Austrian pine is merely a variety, once promised to become valuable in the forests of southern Massachusetts. It has now been shown, however, that this tree is not hardy in our climate.

The Norway spruce (*Picea excelsa*) has for many years been the most widely distributed and most generally cultivated foreign tree in Massachusetts. This tree, thirty years ago, had much, apparently, to recommend it to American planters. It is cheaply raised and easily transplanted; the young plants grow with surprising rapidity and vigor, and are hardly surpassed in grace and beauty by the young of any other of the spruces which will thrive in our climate. The general introduction of this tree into our plantations must nevertheless be regarded as a public misfortune. It has added nothing to their permanent value and it has interfered with the cultivation of more valuable native trees, like the white pine, the white spruce. The Norway spruce, in spite of its early promise, must be acknowledged to be a complete failure in eastern America. It has passed its prime here and is almost decrepit before it is half a century old; it will never produce timber here, and it becomes unsightly just at that period of life when trees should become really handsome in full and free development.

It remains to speak of the European larch. Something more is known of this tree in Massachusetts than was known

* A Few Suggestions on Tree Planting, p. 15.

ten years ago,* but not enough yet to speak with anything like certainty of its real and permanent value in Massachusetts plantations. The European larch, at least during the first fifty years of its life, grows here in Massachusetts more rapidly than our American larch, and more rapidly than most coniferous trees of equal economic value.

The following table of measurements of thirty-three trees of European larch recently cut in the Arnold Arboretum will give some idea of the rate of increase this tree may be expected to attain in this State. These trees grew upon the top of a very exposed hill, fully open to the northwest, in good loamy soil about eight inches deep, insufficiently drained, and underlaid by a heavy gravel subsoil. The growth made by these trees seems, under the circumstances, to have been satisfactory. They increased in height at a rate equal to considerably more than a foot a year, and in diameter of trunk more than a quarter of an inch a year, during the whole period.† They would doubtless have made more wood in a better drained and more open soil, although their annual average increase compares favorably with that attained by this tree in Scotland, where, however, it is also an exotic.‡ Every specimen was sound and vigorous when cut, and was still increasing rapidly in diameter. The measurements of maximum diameter were taken two feet above the ground, the minimum diameter three feet feet below the extreme tips of the trees.

* A Few Suggestions on Tree Planting, p. 29.

† A number of white pines (*P. Strobus*) had been planted on this hill, and had grown under the same conditions as the larches. Twenty-two of these pines were cut in November, 1885. They were all either sixty-four or sixty-five years old and had reached a height varying from 52 to 79 feet, with a diameter of trunk, two feet from the ground, varying from 17 to 22 inches.

‡ See for the growth of European larch in Scotland, The Forester, by James Brown, 5th ed., p. 722.

TABLE OF MEASUREMENTS OF THIRTY-THREE TREES OF LARIX EUROPÆA CUT IN THE ARNOLD ARBORETUM, NOVEMBER, 1885.

No.	Height.		Diameter.		Layers of Annual Growth.	
			Maximum.	Minimum.	Heart.	Sap.
	Feet.	Inches.	Inches.	Inches.		
1	58	1	12	2	33	18
2	58	8	14½	2	36	20
3	56	6	14	2	33	17
4	56	–	14½	2	35	18
5	55	–	14	2	30	16
6	56	6	14	2	35	15
7	56	3	12	2	28	18
8	55	–	13½	2	32	17
9	36	6	8½	2	24	14
10	58	4	13½	2	29	17
11	57	–	14	2	30	18
12	63	9	13	2	33	19
13	58	8	12½	2	32	14
14	39	7	11	6½	29	16
15	55	10	11½	2	33	13
16	55	8	14½	2	34	19
17	57	8	11½	2	30	14
18	59	7	13½	2	29	16
19	59	10	10½	2	36	14
20	50	2	12½	4½	31	15
21	56	4	12	2	35	13
22	56	7	11½	2	33	15
23	56	11	12	2	34	15
24	61	–	13½	2	35	17
25	38	9	12	5	32	14
26	50	–	12	5	36	17
27	60	2	12	–	33	17
28	48	3	11½	2	34	13
29	55	7	14	2	36	16
30	56	2	14	2	33	16
31	33	6	8	2	24	15
32	39	3	10	2	35	16
33	46	10	12	2	31	17

Specimens of the heart wood, taken two feet from the ground, from Nos. 9, 12, 18, 19 and 31, — that is, from individuals fairly representing the average of the age and development of all the specimens examined, — were submitted to Mr. S. P. Sharples, who has determined their specific gravity and per cent. of ash, in the same manner that similar determinations have been made by him upon the native woods of the United States.* The wood upon which these determi-

* Final Reports 10th Census of the United States, vol. ix., pp. 247 *et seq.*

nations were made was artificially dried until it refused to give off moisture, and was therefore absolutely dry.

LARIX EUROPÆA.

No.	Specific Gravity.			Ash.		
	Determinations.		Average.	Determinations.		Average.
9	0 4712	0.4139	0.4425	0.23	0.19	0.21
12	0.5723	0.5055	0.5399	0.10	0.07	0.08
18	0.5823	0.5714	0.5768	0.16	0.10	0.13
19	0.5506	0.5494	0.5500	0.07	0.09	0.08
31	0.5172	0.5139	0.5155	0.16	0.16	0.16
	Average, . . .		0.5249	Average, . .		0.13

It is interesting to observe that the oldest and largest trees produced the heaviest and therefore the most valuable wood, but even after omitting the two small trees, Nos. 9 and 31, from the average, this test, if it is acknowledged that the specific gravity of any wood is the best general indication of its value for fuel or construction, does not suggest any remarkable value in European larch wood grown in Massachusetts. The heaviest of these pieces of European larch wood (0.5823) is much lighter than the heaviest piece of native larch wood (0.7779) tested in the same manner in the United States Census investigations, while the average of the specific gravity of fifteen specimens of the native larch then tested was 0.6236 against 0.5249 for the ten specimens of European larch tested. This Massachusetts-grown European larch wood is heavier and harder, nevertheless, than many American woods. It is heavier than the wood of the Douglas or Oregon fir, the most valuable timber of western North America, and of the western yellow pine; it is heavier than any pine wood grown in Massachusetts, and it exceeds in specific gravity the wood of all the firs, spruces and hemlocks of the United States.*

The European larch grows rapidly upon the poorest soil

* Sargent, The Woods of the United States, Table 11, p. 153.

of Massachusetts; it has begun even to reproduce itself here spontaneously, and there is good reason for believing that it will become a long-lived and valuable tree here. The wood which it produces here is hard, solid and durable, and well suited for fencing and railway ties. It is doubtful, however, if it is desirable at present, at least, to introduce this tree generally as a permanent timber tree into Massachusetts. Sufficient time has not elapsed since its first general cultivation in New England to make it certain that the larch will not, before reaching full maturity, like so many other European trees, utterly disappoint the planter. It is doubtful, too, in spite of all that has been written — and no one has spoken more strongly upon this subject than I — about the advantage to be derived from cultivating this tree in Massachusetts, whether the European larch can properly have any permanent place in our forests. Indeed it seems to be more evident every year that the European larch can do nothing for us which some of our native trees cannot do better and more economically. The larch will grow and make timber rapidly upon poor soil; but soil which will produce good larch timber will produce white pine, and white pine is a far more valuable article commercially than larch. Larch timber is valuable here for fence posts, railway ties, and similar purposes, where durability with contact with the soil is necessary. The wood of our native chestnut possesses these qualities to an admirable degree, and the chestnut will flourish on land not much better than that which will produce larch. It is now known that chestnut railway ties are far more valuable than larch ties, and the chestnut can be more cheaply and easily grown than the larch, and will make timber more rapidly. In a State, therefore, where the native white pine will thrive upon its poorest land, and the native chestnut can be depended upon to furnish posts and ties economically, it does not seem necessary to introduce a foreign tree, especially when no more is known about it than is now known about the larch, whose only real merits are that it will flourish upon poor soil and produce durable timber. This tree can perhaps, however, be profitably grown in the region north of Massachusetts, beyond the natural range of the chestnut, and where no native tree pro-

ducing such durable wood as rapidly as the European larch is to be found.

Many of these facts relating to the behavior of European trees in this country are now well known to nurserymen and other experienced planters. People nevertheless continue to plant foreign trees, and especially European trees, very largely. Probably where one native tree is now planted in Massachusetts, five foreign trees are planted here, and this in a region where the native forest is rarely surpassed in the individual beauty and value of the trees that compose it. The cause of this unfortunate condition of things will be found in the ignorance and indifference of planters, and in the shortsightedness of nurserymen who supply them with trees. The fault, if fault there is, in this matter, lies with the purchaser, however, rather than with the seller. The nurseryman, as long as he can find a market at good prices for cheaply grown foreign trees, can hardly be expected to sacrifice immediate profits in creating a demand which does not now exist for better material, wise as such a policy would doubtless be for him in the long run. When Massachusetts planters study trees in Massachusetts woods and fields instead of in the trade catalogues of foreign and domestic tree dealers, and thus learn to take advantage of the wonderful sylva which nature has spread over eastern America, our plantations will attain an importance and value now unknown to them. In the meantime nurserymen will continue to raise and planters will continue to purchase the very trees which over and over again have proved themselves utterly unfit to receive any place in our plantations. The mistake is discovered and the lesson is learned in the end, but only at the price of serious disappointments, and generally only when it is too late to take advantage of such dearly bought experience.

Massachusetts, in spite of our many sins of omission and commission, has made some substantial progress in the art of sylviculture. Her most instructive plantations, however, are not those which have been made upon the European fashion, or rather with European trees, by men who have studied the subject in Europe or in European books upon forestry, instructive and valuable as all such plantations have

certainly been in showing us what to avoid. The real progress in sylviculture in Massachusetts has been made by the farmers of Barnstable and Plymouth counties, who have taught us how to plant and raise forests successfully and profitably under the most favorable conditions. The secret of their success must be sought where they sought and found it, not in foreign treatises, unsuited to the requirements of this community, but in the native woods, in full view of their own doorsteps, which told them what to plant and supplied them with material for planting.

It has been demonstrated in Barnstable County that a crop of pitch pine can be raised from seed with as much certainty as a crop of corn, and with much less expense; and that the loose and shifting sands of Cape Cod, useless for every other purpose, can, with the aid of this tree, be made to bear valuable crops of wood. *

Not less interesting, certainly, and perhaps even more suggestive of future development towards the true policy for New England forest management, are the white pine plantations made forty or fifty years ago in Middleborough, Raynham, Bridgewater, and other towns in that part of the State.

These plantations † were made upon barren, sandy soil, entirely exhausted by long cultivation, with seedling pines dug in the neighboring woods. The young trees are set in shallow furrows, at odd times, without interfering with other farm work, and so with little expense to the farmer. A distance varying from five to twelve feet in different plantations was left between the trees, which, after planting, received no subsequent care or thinning. These trees, with few exceptions, have grown rapidly and with great vigor, and are now worth, on the stump, sixty to seventy-five dollars an acre; and men are still living in these towns who have cut and sold white pine saw-logs at the rate of $150 an acre, from seedling plants set by themselves. Here, no doubt, are the most successful and profitable attempts at

* An interesting account of these pitch pine plantations, which already cover more than 10,000 acres in the aggregate, appeared in the Report of the Connecticut State Board of Agriculture for 1877-8, from the pen of Mr. J. H. Bowditch.

† Mr. Avery P. Slade, of Somerset, first described these white pine plantations in a lecture delivered in Boston before the Massachusetts Horticultural Society on January 17th, 1885, and which was afterwards published in the transactions of the Society.

sylviculture ever made in the United States, not even excepting Mr. Zachariah Allen's earlier plantations made in Rhode Island with native deciduous trees.*

These plantations are valuable, not in the great amount of timber which they have produced, but because they show how our farmers, with a trifling outlay, can improve their farms, by covering worn-out and unproductive land with a valuable crop, which, if left to mature, will continue to increase in value for generations. They show that white pine, the most valuable tree in New England, can be successfully and profitably cultivated; but unfortunately they do not yet show the method of culture which can best be adopted in order to make this tree yield the greatest returns.

More experiments and more comprehensive experiments with the white pine are needed. No one knows yet how to raise a crop of white pine seedlings from seed grown in the open fields, with the same almost absolute certainty with which a crop of pitch pine can be raised. No one knows whether it is better to plant white pines four feet apart or twelve feet apart, and no one knows at what period of their growth the young plantations should be thinned, or whether they should be thinned at all. There are abundant theories upon all these subjects, but they are theories unsubstantiated by the long and carefully conducted experiments actually necessary before the most economic and profitable method for the cultivation of any timber tree can be determined upon. This is a subject of great importance to the agricultural prosperity of New England. The original supply of white pine is rapidly disappearing before the constantly increasing demands for this lumber, and white pine logs must inevitably become one of the most valuable of all American products. The climate and soil of a great part of New England are peculiarly suited to the white pine. Nowhere else are there now such extensive, vigorous and thrifty young forests of this tree as may be found in many parts of New England; and nowhere is it growing with greater promise than upon the exhausted and abandoned fields of this State. It will give to these fields, one of these days, a value which they have never possessed before, and

* Notes on Trees and Tree Planting, p. 20.

of which their owners have probably but little idea. It is clearly for the interest of New England to protect and extend these young plantations; to guard them from the fires which are everywhere and always threatening their destruction, and not only the destruction of the trees themselves, but the ability of the soil to bear them. It is clearly for our interest, too, with so much land unfit for almost any other crop, to learn by actual experiment more about the requirements of this tree in cultivation, and to learn, if possible, how to plant forests of white pine economically, and how best to guard and develop the young forests which are springing up naturally.

There are other trees besides the white pine which the farmers of Massachusetts can cultivate with profit. The wood of some of the native trees of Massachusetts is in great demand, and will soon become rare and expensive everywhere. The best hickory has already been cut, and as no wood has ever been found to take the place of hickory for the particular uses to which that wood is applied, and as there is no hickory except in the United States, the value of any farm can now be increased by a plantation of hickories. White ash of good quality has also become very scarce, and there can be no loss in planting this tree wherever good land can be spared for it, or in protecting and encouraging the young plants wherever they have sprung up spontaneously. Chestnut, too, must always be in demand for railway ties and fence posts, and there are rocky and unproductive hills in every town in the State, which might profitably be covered with groves of this tree.

This question of a supply of railway ties is now so interesting to the students of forest statistics, and as the farmer sooner or later will have, here in New England, at least, to raise the ties for the railroads, it will not, I hope, be out of place if I add to these notes about trees what little I have been able to learn in the last few years in regard to the value of different woods for this purpose.

The Boston and Providence Railway Corporation began in 1878, at my suggestion, an experiment for the purpose of determining the value of different woods for cross ties. Fifty-two ties were laid on the 12th or 13th of December,

under the direction of Mr. George F. Folsom, master carpenter of the corporation, who has had, from the beginning, the entire charge of the experiment, in the main outward track, at a point beginning 775 feet west of the Tremont Street crossing in Boston. The traffic at this point is very heavy, an average of sixty-five trains passing over this track daily.

The following ties were laid: —

Nos. 1 to 3, American Larch.
Nos. 4 to 12, White Oak.
Nos. 13 to 18, European Larch.
Nos. 19 to 24, Western Catalpa.
Nos. 25 to 30, Ailanthus.
Nos. 31 to 36, Black Spruce.
Nos. 37 to 38, Southern Hard Pine.
Nos. 39 to 40, White Elm.
Nos. 41 to 46, Hemlock.
Nos. 47 to 52, Canoe Birch.

The European larch ties (Nos. 13 to 18), were cut from trees grown in the plantation of the late Richard S. Fay, near Lynn, in Essex County, about thirty years old. The catalpa ties (Nos. 19 to 24), were furnished by the late E. E. Barney, of Dayton, Ohio, who for many years before his death was zealously engaged in making known the value of the catalpa tree, and the remarkable durability of its wood. The ailanthus ties were from the trees grown in the town of Bristol, R. I.

The remaining twenty-two ties, spruce, hard pine, elm, hemlock and canoe birch, had been creasoted by the Hayford process, and were included in the experiment at the request of Mr. Edward R. Andrews.

One American larch tie had to be removed from the track in October, 1883; it will probably be found necessary to remove the other ties during the present year.

One white oak tie had become so worn that it had to be removed from the track in October, 1883. The remaining eight are but little worn, and will probably last for many years longer.

Of the European larch, four were worn out and taken from the track in June, 1883; one in October of the same

year; the sixth and last will be removed during the present year.

The catalpa ties have all been taken from the track, two in June, 1883, one in July, 1884, and two in October, 1885.

The first tie of the fifty-two to give out was an ailanthus, removed in November, 1882; two ailanthus ties were taken out in October, 1883, and two in July, 1884; one still remains in the track, but little worn and apparently as sound as when laid down.

Two spruce ties were removed in July, 1884; the remainder will have to be removed during the present year.

The two ties of southern pine are already so greatly worn that it will be necessary to remove them from the track during the present year.

The hemlock are now badly worn, and it will doubtless be necessary to take them from the track during the present year.

The two elm and the six birch ties are perfectly good and sound, and show but little indication of wear.

This experiment is not yet completed, and this statement of the behavior of the different woods, which Mr. Folsom has prepared, is, of course, only preliminary to a more detailed report upon the subject.

None of the ties which have been removed from the track were decayed, with the exception of the ailanthus taken out in November, 1882; and this stick was defective and partly decayed when laid down. The other ties taken out have been worn out by pressure, and not by decay. The whole mass of wood directly under the rail has been so crushed and disintegrated, to the depth of the spike holes,— $5\frac{1}{2}$ inches, — that the spikes have no hold upon the tie, which has to be abandoned. This experiment, if it has done nothing else, has confirmed the opinion of the most experienced railway engineers, that ties do not rot out, and, therefore, ability to resist decay in contact with the soil is a less important quality in a wood to be used for this purpose than ability to resist a direct crushing and wearing pressure.

The experiment shows, as might have been expected from the specific gravity of the two woods, that the American-

grown European larch was inferior to the native larch, and that neither of these woods give any remarkable promise of value for this purpose.

The behavior of the catalpa is one of the most interesting features in the experiment. Great attention has of late years been given, in some parts of the country, to the cultivation of the western catalpa, and it has often been stated that its practical indestructibility when placed in the soil would make it one of the most valuable woods for railway ties.

The catalpa is a soft, light wood, with a specific gravity of only 0.4165; and it has not shown its ability to resist the heavy and constant traffic of the Providence Railroad as well as white oak and other heavier and harder woods. The two catalpa ties taken from the track in October, 1885, that is, after four years and eight months' service, are perfectly sound except under the direct bearing of the rails. These had cut down into the wood to the depth of five-eighths of an inch, while the whole mass of wood under the rail is reduced nearly to pulp by the separation of the layers of annual growth and the breaking of the fibre. This disintegration has penetrated so deeply that if the ties, otherwise perfectly sound, were turned over, the wood which would then come under the rail would not have sufficient thickness to hold the spikes. The pressure, however, to which these ties have been subjected has been unusually severe, and there is nothing in the behavior of these catalpa ties to show that they would not, in a road with lighter traffic, have stood for a number of years, and resisted as well and probably better than ties made from any other equally soft and less durable wood. The result thus far obtained with the ailanthus wood is not satisfactory; the wood was not well selected, and one tie was practically useless before it was laid. Ailanthus wood, however, is hard and solid and will probably make excellent ties.

The spruce, southern pine and hemlock, although creasoted, did not give much better results than the uncreasoted larch, and it is evident, therefore, that it will not pay to use any of these woods for this purpose.

The result, on the other hand, with the creasoted elm and birch has been highly satisfactory. These are hard, solid

woods, but so liable to decay in contact with the soil as to be unfit for ties unless protected by some preserving process. Elm and birch are easily cultivated and grown with rapidity; and as ties of these woods can be sold cheaply, they should, with a cheap and effective preserving process, form important factors in the tie supply of the Northern States.

The white oak has proved the most enduring of all the uncreasoted ties laid down for this experiment; and white oak would make the very best tie which could be raised in New England, were it not that it holds spikes so firmly that it is practically impossible to draw them, when it becomes necessary to shift or change the rails. For this reason chestnut, unfortunately not included in this trial, makes, all things considered, a better tie than oak, and the best tie which can be grown in Massachusetts. It is durable, solid, and withstands crushing better than almost any of our native woods in their natural state, always excepting the white oak. It is easily raised and thrives upon rough and rocky land unsuited for tillage. The chestnut tree suckers freely and vigorously from the stump when cut, and in this way will continue to produce three or four crops of tie timber. The inferences which it is, at this time, safe to draw from this experiment are, that for Massachusetts railroads chestnut and white oak make the best ties; and that other hard, compact and low-priced woods, like elm and birch, not naturally durable enough for the purpose, can be made valuable through some preserving process.

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